

CLAIMS

What is claimed is:

- 53
C
1. A device for target scoring, comprising:
 - a. an elongated retro-reflective member;
 - b. a first light source disposed at a first location spaced apart from the retro-reflective member and positioned so as to be able to direct a first beam of light toward the retro-reflective member;
 - c. a second light source disposed at a second location spaced apart from both the retro-reflective member and from the first light source, the second light source positioned so as to be able to direct a second beam of light toward the retro-reflective member so that the second beam of light intersects the first beam of light over an area defining a target area;
 - d. a first light sensor, disposed adjacent the first light source and positioned so as to be able to receive light from the first light source that has been reflected from the retro-reflective member, that generates a first signal indicative of a first position of a first blockage of illumination from the retro-reflective member;
 - e. a second light sensor, disposed adjacent the second light source and positioned so as to be able to receive light from the second light source that has been reflected from the retro-reflective member, that generates a second signal indicative of a second position of a second blockage of illumination from the retro-reflective member; and
 - f. a processor responsive to the first signal and to the second signal that is programmed to determine a location of the object in the target area, based on the first position of the first blockage of illumination and the second position of the second blockage of illumination.

2. The device of Claim 1, wherein the elongated retro-reflective member comprises a first reflective surface disposed on a first plane and a second reflective surface disposed on a second plane intersecting the first plane.
3. The device of Claim 1, wherein the elongated retro-reflective member comprises retro-reflective tape.
4. The device of Claim 1, wherein the elongated retro-reflective member comprises a plurality of corner reflectors.
5. The device of Claim 1, wherein the elongated retro-reflective member comprises a plurality of glass beads.
6. The device of Claim 1, wherein the processor is further programmed to ignore objects passing in the target area at less than a predetermined velocity.
7. The device of Claim 1, wherein the processor is further programmed to ignore objects having a cross-sectional diameter greater than a predetermined amount.
8. The device of Claim 1, wherein the processor is further programmed to ignore objects which are present within the target area for an amount of time that is greater than a first predetermined period or less than a second predetermined period.
9. The device of Claim 1, further comprising a frame upon which is mounted the retro-reflective member, the first light source, the second light source, the first light sensor, and the second light sensor.
10. The device of Claim 1, further comprising a structure that holds a target in a position corresponding to the target area.

11. The device of Claim 1, wherein the processor is programmed to generate a virtual image of the object relative to its position in the target area.
12. The device of Claim 11, wherein the processor is programmed to generate a virtual image of a target.
13. The device of Claim 1, wherein the first light source and the second light source each comprise an incandescent lamp.
14. The device of Claim 1, wherein the first light source and the second light source each comprise a laser.
15. The device of Claim 1, wherein the first light sensor and the second light sensor each comprise a charge coupled device camera.
16. The device of Claim 1, wherein the first light source and the second light source each comprises:
- a. an light bulb; and
 - b. a curved mirror, disposed adjacent the light bulb, having a radius of curvature and a distance from the light bulb so that light from the light bulb is projected onto the retro-reflective surface.
17. The device of Claim 16, wherein the light bulb is an incandescent light bulb.
18. The device of Claim 16, wherein the curved mirror has an axis of curvature, the light bulb being disposed along the axis of curvature, and wherein the curved mirror defines an elongated slit that is parallel to and spaced apart from the axis of curvature.

19. The device of Claim 18, wherein each light sensor is disposed adjacent the curved mirror opposite from the light bulb and coaxial with the elongated slit so that light from the retro-reflector is received by the light sensor through the elongated slit.
20. A device for target scoring, comprising:
- an elongated lamp having a first end and a second end;
 - a first light sensor, spaced apart from the elongated lamp and disposed so as to be able to receive light from every point along a first portion of the elongated lamp and capable of detecting a blockage of light from a second portion of the elongated lamp, the first light sensor generating a first signal indicative of an angular position of the blockage relative to a predetermined axis;
 - a second light sensor, spaced apart from the elongated lamp and from the first light sensor, disposed so as to be able to receive light from every point along the first portion of the elongated lamp and capable of detecting the blockage of light from the second portion of the elongated lamp, the second light sensor generating a second signal indicative of an angular position of the blockage relative to the predetermined axis; and
 - a processor responsive to the first signal and to the second signal that is programmed to determine a location of the object in a target area, based on the angular position of the blockage.
21. A method of determining a location of an object, comprising the steps of:
- directing a first beam of light from a first light source toward a retro-reflective member;
 - directing a second beam of light from a second light source toward the retro-reflective member;
 - determining a position of a first shadow cast by the object onto the retro-reflective member as it is illuminated by the first beam;

- cont. 1
- d. determining a position of a second shadow cast by the object onto the retro-reflective member as it is illuminated by the second beam; and
 - e. determining the location of the object by determining the point where a line from the first light source to the first shadow intersects a line from the second light source to the second shadow.

22. An apparatus for determining a location of an object, comprising the steps of:

- a. means for directing a first beam of light from a first light source toward a retro-reflective member;
- b. means for directing a second beam of light from a second light source toward the retro-reflective member;
- c. means for determining a position of a first blockage of illumination from the retro-reflective member as it is illuminated by the first beam by an object;
- d. means for determining a position of a second blockage of illumination from the retro-reflective member as it is illuminated by the second beam by the object; and
- e. means for determining the location of the object by determining the point where a line from the first sensor to the first blockage of illumination intersects a line from the second sensor to the second blockage of illumination.

23. An apparatus for determining a location of an object having a retro-reflective outer surface, comprising the steps of:

- a. means for directing a first beam of light from a first light source toward the object;
- b. means for directing a second beam of light from a second light source toward the object;
- c. means for determining a position of a first reflection from the object as it is illuminated by the first beam;

- Copy
- d. means for determining a position of a second reflection from the object as it is illuminated by the second beam; and
 - e. means for determining the location of the object by determining the point where a line from the first light source to the first reflection intersects a line from the second light source to the second reflection.

006030" 6T606560